Life History Parameters of Common Nearshore Marine Fishes

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Contractor: MBC Applied Environmental Sciences
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The Issue

A significant portion of California's generation capacity, approximately 45 percent, is represented by facilities located along the state's coast and estuaries that use once-through cooling technology. This cooling technology requires the withdrawal of significant amounts of water (~17 billion gallons per day) that is passed by the condenser and then discharged back into a water body. Although some of these facilities have been operating since the 1950s, scientific understanding of the ecological effects of the use of once-through cooling is quite limited. The impacts of cooling water withdrawals are characterized as *entrainment*, where small aquatic organisms are carried by the cooling water into the power plant and killed by heat, and as *impingement*, where the cooling water intake traps larger organisms against the intake screens.

Under Section 316(b) of the Federal Clean Water Act, the operators of stations using once-through cooling are required to demonstrate the entrainment and impingement of fish and shellfish residing within the source waters for their respective cooling water system. Previous entrainment and impingement monitoring has identified key species that are commonly impinged or entrained in relatively high numbers in the Southern California Bight. When researchers try to determine what such data mean on a larger scale—for example, to those species' overall populations—they use *life history parameters* to do so.

Life history parameters are specific metrics such as growth rates, age at maturity (the latter two may be collectively referred to as "age and growth"), fecundity, and size structure of the population. Life-history-based mathematical models attempt to explain population-level effects using such parameters. These models allow researchers to use larval abundance data to infer, for example, numbers of adult fish lost. However, the determination of impacts is severely impeded by information gaps in the understanding of key species' life history. To fully evaluate the interaction between the operation of a once-through cooling system and the fish found in the region on a species-by-species basis, relevant data gaps must be addressed.

Project Description

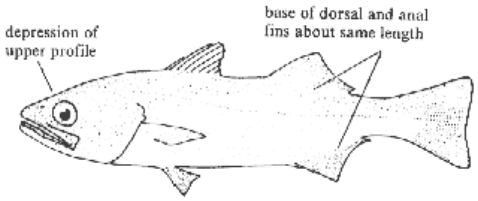
MBC Applied Environmental Sciences is studying the early life history parameters of several species commonly impinged or entrained in once-through cooling systems of power generating stations. The information obtained from this effort will provide for greater inferential strength for all of the commonly employed models utilized for analysis of entrainment data. The study will also increase general understanding of the interaction between once-through cooling water intake structures and fish species being studied.

This two-year investigation includes the following elements:

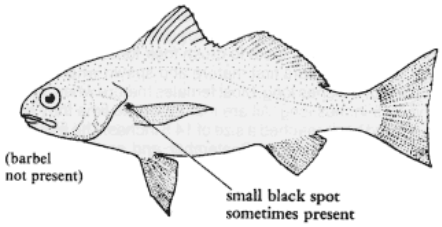
1. Daily Age Assessments will identify the age-to-length relationship for larval white croaker, spotfin croaker, and queenfish. The analysis will rely upon existing samples collected during the 2003–2004 Huntington Beach Entrainment and Impingement Study. This will provide for a mechanism for quickly determining the age of croaker subsequently entrained; croaker are commonly entrained in this area.

2. Age and Growth, Fecundity, and Spawning Seasonality will be investigated for four key species using newly collected and archived samples: yellowfin croaker (age and growth, fecundity, and spawning seasonality), spotfin croaker (fecundity), and queenfish (age and growth). These parameters are necessary for using life-history based models to predict the impacts of entrainment losses on a population level, and they are presently poorly estimated.

3. Impingement Sample Collection from May 2006 through May 2007 will supplement existing fish samples used under element 2 above. Collections will be made at generating stations throughout Los Angeles and Orange County, with at least 100 offshore trawl samples collected. Data from these collections will be compared with existing impingement samples.



Queen fish illustration from the California Department of Fish Game website



White Croaker illustration from the California Department of Fish Game website

This research will provide managers and analysts with the life history information necessary to better parameterize models designed to illuminate the relationship between entrainment and the populations at risk. Additionally, the adult life history information will help researchers assess the interaction between impingement and the population dynamics of those species being investigated. All of the currently employed demographic models require extensive information regarding life history parameters, much of which is unavailable. With this research, items such as daily growth rate of larvae, as well as maximum life span, fecundity, age at first maturity, and

spawning season can be more accurately described for commonly entrained nearshore marine fish species.

PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objectives:

- **Improving the environmental costs/risk of California's electricity.** This work will provide a wealth of entrainment/impingement information for the studied species, enabling researchers and those needing to address Section 316(b) of the Federal Clean Water Act much more effectively.

The project also meets the PIER's goals to conduct research and development activities that will advance science or technology not adequately addressed by the competitive and regulated markets that evaluate and resolve environmental effects of energy delivery in California.

Final Report

PIER-EA staff intend to post all the final project reports on the Energy Commission website as the research is completed (fall 2008 for the program final report) and will list the website links here. All reports are also posted at the Water Intake Structure Environmental Research (WISER) website, at http://ecomorphology.mlml.calstate.edu/WISER.html.

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